For use with PCB part number: 35307

Half-chip PRM®-RS Customer Board User Guide

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The half-chip PRM-RS Customer Board described in this document is designed for use with the Remote Sense (RS) family of half-chip PRMs, and demonstrates the benefits of Factorized Power Architecture™. This demonstration board is not designed for installation in end-user equipment. The system demonstrates the use of a PRM Regulator and a VTM® Current Multiplier for general laboratory evaluation only.

Please read this document before setting up a customer demonstration board.

The User Guide is not comprehensive and is not a substitute for common sense and good practice. For example:

1. When testing electronic products always use approved safety glasses.
2. Provide a strain relief for wires and place the system on the bench in such a way as to prevent accidental dislodgment from the bench top.
3. Remove power and use caution when connecting and disconnecting test probes and interface lines to avoid inadvertent short circuits and contact with hot surfaces.
4. Never use a jumper in place of the fuse. Replace the fuse only with its equivalent type and rating.
5. Never attempt to disconnect the demonstration board from a VTM Customer Board while power is applied. This system is not designed to demonstrate hot plug capability.

1.0 Introduction

The half-chip PRM-RS Customer Board can be used to demonstrate a stand-alone regulator or in conjunction with a VTM Customer Board to enable demonstration of a Factorized Power Architecture (FPA) system. There are many combinations possible using PRM® and VTM Customer Boards, but the focus in this user guide is using one PRM Customer Board and one VTM Customer Board. The half-chip PRM Customer Board can be configured for local sensing (at the PRM output), or non-isolated remote sensing (at the VTM output). The half-chip PRM Customer Board is nominally configured for local sensing where the voltage feedback circuit regulates the output voltage of the PRM. Implementing remote sensing requires component changes and rework to the board which is detailed in section 8.3.

1.1 Part Numbers and Ratings

Refer to the specific PRM data sheet for ratings of the device. It is important to remain within the device limits when testing.

1.2 Contents

The half-chip PRM-RS Customer Board arrives with the following contents:

1. 1 x half-chip PRM-RS Customer Board fully populated
2. 1 x 11mm VI Chip® push pin heat sink
3. 2 x VI Chip push pins for heat sink installation
4. 2 x VI Chip push pin heat sink grounding clip
5. 2 x 10 pin male to male headers

2.0 Features

The half-chip PRM-RS Customer Board has the following features:

1. Input and output lugs for source and load connections
2. Input fuse (appropriately rated)
3. Input capacitor for source decoupling
4. Test points for access to various device pins and circuit voltages
5. Trim pot for adjusting the output voltage set point
6. Voltage regulation, and current sensing circuitry appropriately set for proper operation
7. Recommended output filter inductor
8. Dual output headers (female) for transferring power and signal connections to downstream VTM® Customer Board.
9. Switch for enabling / disabling the device through the PC pin
10. Oscilloscope probe jack for making accurate output voltage measurements
11. Provisions for installing custom VI Chip® push pin heat sink with grounding clips (optional, included with board)

3.0 Board Description

The following section provides a detailed description of the half-chip PRM-RS Customer Board components and test points.

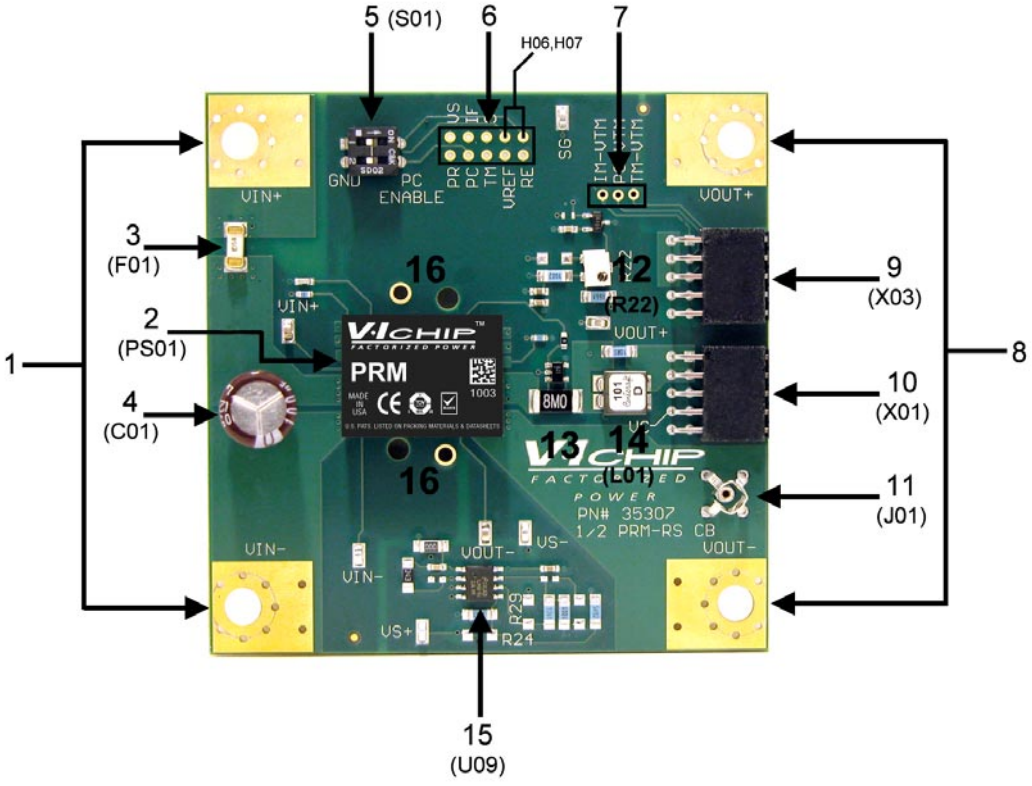
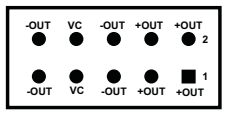
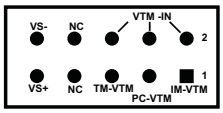


Figure 1
Board Description

Figure 2
Power / Signal Connectors Pinout, Front View



X01
Power / Signal Connector (10)



X03
Signal Connector (9)

3.1 General Components

Refer to Figure 1 and Figure 2:

1. Input Lugs: Sized for #10 hardware. Use these for making connections to the input source. This board does not contain reverse polarity protection. Check for proper polarity before applying power.
2. Half-chip PRM-RS module (PS01)
3. Input Fuse (F01): 10 A rated
4. Input Capacitor (C01): 100 µF, 63 V capacitor allows for stable operation with most input sources.
5. Enable / Disable Switch (S01): Dual switch with the following functionality:
   a. S01_1 (Top): Spare switch. Wired to H07 and H06 on the PRM signal test point header (#6) to allow for extra functionality if needed. Both positions are open and not connected anywhere else on the board.
   b. S01_2 (Bottom): PC enable switch. When in the right position (ON), the PC pin will be connected to –IN and the device will be disabled. When in the left position, PC will be open, and the device will be enabled.
6. Signal Test Point Header: Dual row of plated through hole test points for making measurements or connections to the signals labeled.
7. VTM® Signal Test Point Header: Plated through holes for measuring VTM signals returned through connector X03. For use only with VTM Customer Boards containing dual headers.
8. Output Lugs: Sized for #10 hardware. Use these lugs to connect the output directly to the load
9. Signal Connector (X03): Used to transfer the VTM PC, IM, TM, and output sense signals between the PRM and VTM Customer Boards. For use only with VTM Customer Boards containing dual headers. Refer to Figure 2 for pinout.
10. Power / Signal Connector (X01): Used to transfer power (+/-Out) and VC to downstream VTM Customer Board when used. For use with all VTM Customer Boards. Refer to Figure 2 for pinout.
11. Output Oscilloscope Probe Jack (J01): Used for making accurate scope measurements of the output voltage (i.e. ripple). Remove scope grounding lead and insert probe directly into jack ensuring a good connection between the jack and the probe ground barrel. Do not attempt to install while power is applied. May not be compatible with all scope probes.

12. Output Voltage Trim Pot (R_{22}): 11 turn trim pot adjusts the output voltage by increasing or decreasing the error amplifier reference voltage (V_{REF}). Turn clockwise to increase the output voltage, and counterclockwise to decrease the output voltage. Adjustment slot is 1.5 mm (L) x 0.6 mm (W).
13. High Side Current Sense Circuit (R_{08}, Q_{02}): Current sense shunt and IC monitor the output current and provide feedback to the IF pin for current limit protection. Gain is typically 400 mV/A, and is set for appropriate current limit set point. IF signal can be monitored at the Signal Test Point Header (#6) to provide approximate output current measurement, but should not be used if accurate output current measurements are required (<10% error). Efficiency measurements should always be performed using an external calibrated shunt.
14. Output Inductor (L01): 0.4 uH inductor provides high AC impedance between PRM® and VTM® (when used) to prevent high- frequency switching currents from circulating between devices.
15. Voltage Sense and Error Amplifier (U09A, U09B): Dual op amp provides voltage sensing and error amplifier function. The customer board is nominally configured for local voltage sensing at the PRM output. U09B can be re-configured as a differential amplifier to allow for non-isolated remote sensing at the VTM output or load. This requires rework as described in Section 8.3.
16. Push Pin Heat Sink and Grounding Clip Mounting Holes: Use these holes for installing the optional push pin heat sink and grounding clips included with the board.
    Use of a heat sink is highly recommended for appropriate cooling of the PRM.

3.2 Test Points

In addition to the Signal Test Point Headers (#6, #7), there are a number of surface mount test points on the board with the following functions.

1. V_{IN+}, V_{IN-} (TP01, TP03): Input voltage test points provide Kelvin connections to the input leads. Use these test points for measuring the input voltage to avoid error due to interconnect losses.
2. V_{OUT+}, V_{OUT-} (TP04, TP05): Output voltage test points provide Kelvin connections to the output leads. Use these test points for measuring the output voltage to avoid error due to interconnect losses.
3. Signal Ground (TP01): Signal Ground (SG) test point is the ground reference for all control circuitry.
4. VS+, VS- (TP10, TP11): +/- sense inputs to the differential amplifier when remote sense is implemented. When used with a VTM Customer Board, the sense leads may be wired to the VTM output voltage through X03 depending on which VTM board is used. If not, a twisted pair of wires can be used to connect sense leads to the VTM board output from these test points.

4.0 Schematic, Assembly and Bill of Material (BOM)

4.1 Schematic

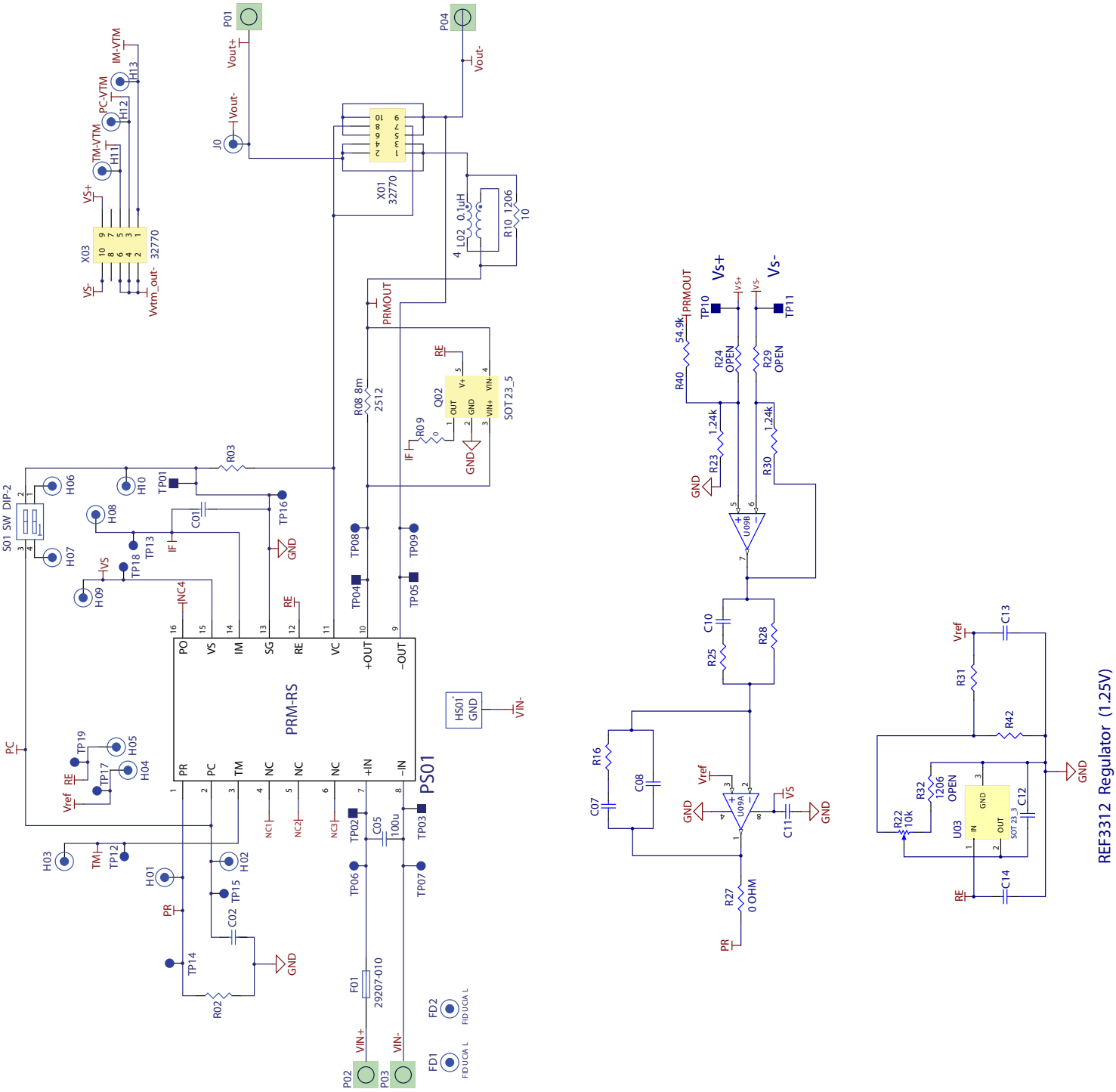
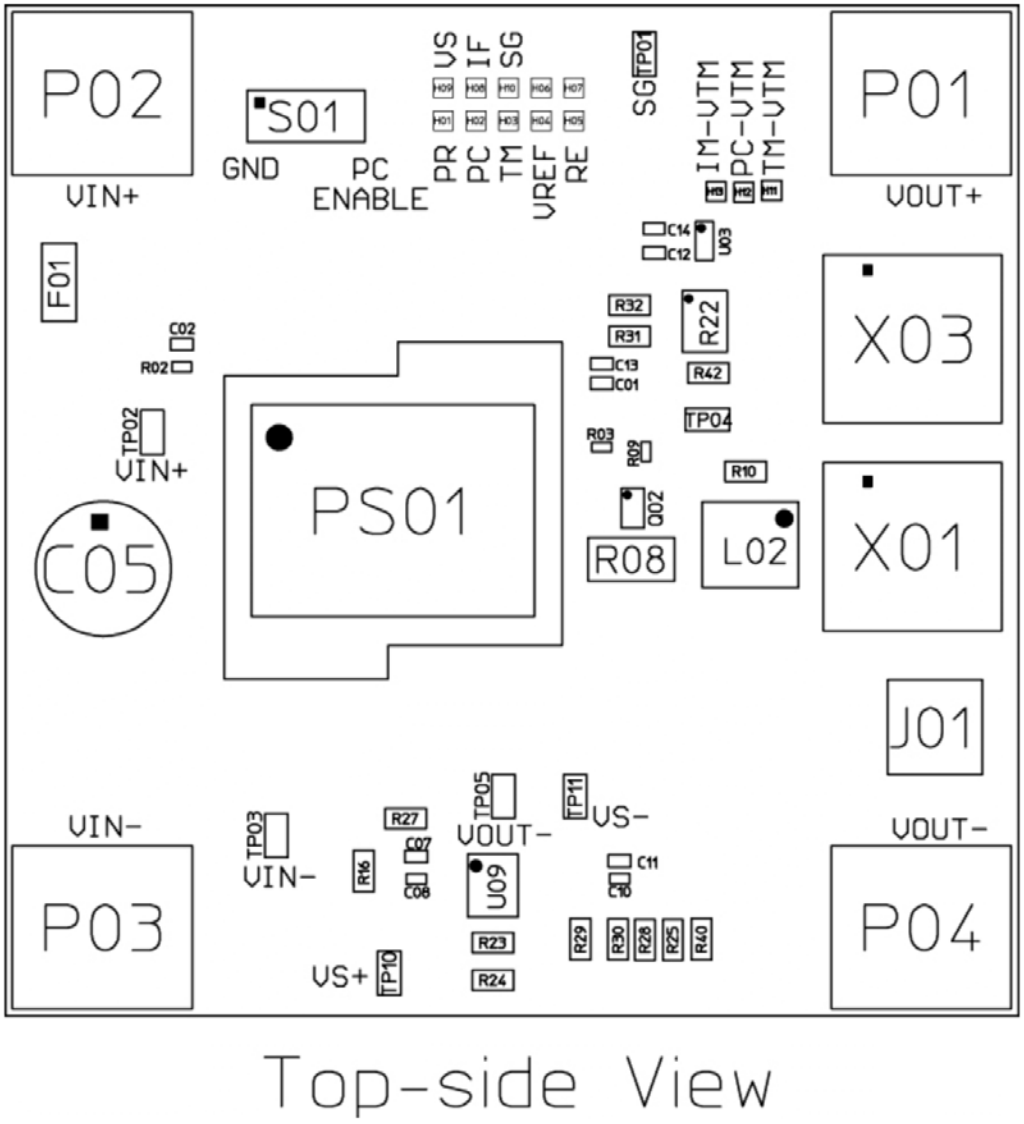


Figure 3: Half-chip PRM-RS Customer Board Schematic

4.2 Assembly Drawing

Figure 4
Half-chip PRM-RS
Customer Board
Assembly Drawing



4.3 Bill of Materials

Table 1
Half-chip PRM-RS Customer Board BOM

Ref. Des.	Description	Manufacturer	Manufacturer Part Number
C01	Not Applied	Not Applied	Not Applied
C02	Not Applied	Not Applied	Not Applied
C05	CAP ALEL 100uF 20% 63 V 0.2 radial	U. CHEMI-CON	EKME630Ell101MJC5S
C07	CAP X7R 0.01uF 10% 100 V 0603	Generic	Generic
C08	Not Applied	Not Applied	Not Applied
C10	Not Applied	Not Applied	Not Applied
C11	CAP X7R 0.01uF 10% 100 V 0603	Generic	Generic
C12	CAP X7R 0.10uF 10% 16 V 0603	Generic	Generic
C13	CAP X7R 0.22uF 10% 25 V 0603	Generic	Generic
C14	Not Applied	Not Applied	Not Applied
F1	Littlefuse 10 Amp R451010.MRL	Littlefuse	0451010.MRL
J01	Jack Vertical Mech Thru Hole	Tektronix	131-5031-00
L02	Ind 0.1u/20%/20A dual 3026	Coilcraft	SLC7530D-101MLC
PS01	Model Specific	Vicor	Model Specific
Q02	IC I Sense INA194 SOT23 5	TI	INA194
R02	Not Applied	Not Applied	Not Applied
R03	RES 1K OHM 1W 1/10W 1% 0603	Generic	Generic
R08	RES I Sense 8m OHM 1W 1% 2512	Generic	Generic
R09	RES 0 OHM Jumper 1A 0603	Generic	Generic
R10	RES 10 OHM 1/4W 1% 1206	Generic	Generic
R16	RES 17.4K OHM 1/4W 1% 1206	Generic	Generic
R22	RES TRIM POT 10K OHM 1/4W 10% SMD	Murata	PVG5A103C03R00
R23	RES 1.24K OHM 1/4W 1% 1206	Generic	Generic
R24	Not Applied	Not Applied	Not Applied
R25	Not Applied	Not Applied	Not Applied
R27	RES 0 OHM 1/8W 5% 1206	Generic	Generic
R28	RES 1K OHM 1/4W 1% 1206	Generic	Generic
R29	Not Applied	Not Applied	Not Applied
R30	RES 1.24K OHM 1/4W 1% 1206	Generic	Generic
R31	RES 10K OHM 1/4W 1% 1206	Generic	Generic
R32	Not Applied	Not Applied	Not Applied
R40	RES 54.9K OHM 1/4W 1% SMD 1206	Generic	Generic
R42	RES 4.99K OHM 1/4W 1% 1206	Generic	Generic
S01	SW DIP SPST 2 POS	C&K	SD02H0B
TP01	Test Point, Surface Mount	Keystone	5017
TP02			
TP03			
TP04			
TP05			
TP10			
TP11			
U03	IC VREF 1.25V REF3312 SOT23 3	TI	REF3312
U09	IC DUAL OPAMP LM6142AIM 8PIN SO	National	LM6142AIM
X01	CONN 10POS 90° Thru-Hole Female 0.100SPC	Sullins	PPTC052LJBN-RC
X03			
ACCESSORY 1	HS XF 11mm Half VIC	Vicor	32784
ACCESSORY 2	Clip Heat sink Grounding	Vicor	33855
ACCESSORY 3	CONN 10POS Header STR M-M 3A/0.100	Sullins	PEC05DABN
ACCESSORY 4	Push-Pin White 0.063”	Vicor	34141

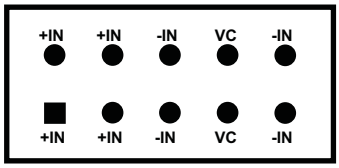
5.0 VTM® Customer Boards

The half-chip PRM-RS Customer Board is designed to work with all types of VTM Customer Boards to facilitate testing of virtually any PRM®/VTM combination. Note that there are currently two basic types of VTM Customer Boards. Both board types share many common features, including input capacitance, output capacitance, and various test points. The main difference between the two board types is the number of connectors. Before configuring a PRM/VTM setup, the user should identify which type of VTM board is being used.

5.1 VTM Customer Board Type A (Single Connector)

The VTM Customer Board Type A contains a single power / signal header designed to mate with only X01 on the half-chip PRM-RS Customer Board. The PRM output voltage, and VC signal are transferred through this header when connected to a PRM Customer Board.

Figure 5
VTM Customer Board Type A



VTM™ CUSTOMER BOARD
TYPE A
Power / Signal Connector

Figure 6
VTM Customer Board Type A
Connector Pinout (Front View)

5.2 VTM® Customer Board Type B (Dual Connectors)

The VTM Customer Board Type B contains dual connectors designed to mate with both X01 and X03 on the half-chip PRM-RS Customer Board. The additional connector is used to transfer VTM signal pins, as well as the VS+ and VS- signals between boards. The VS+ and VS- signals are tied directly to the VTM output and can be used for implementing remote sense as described in a later section.

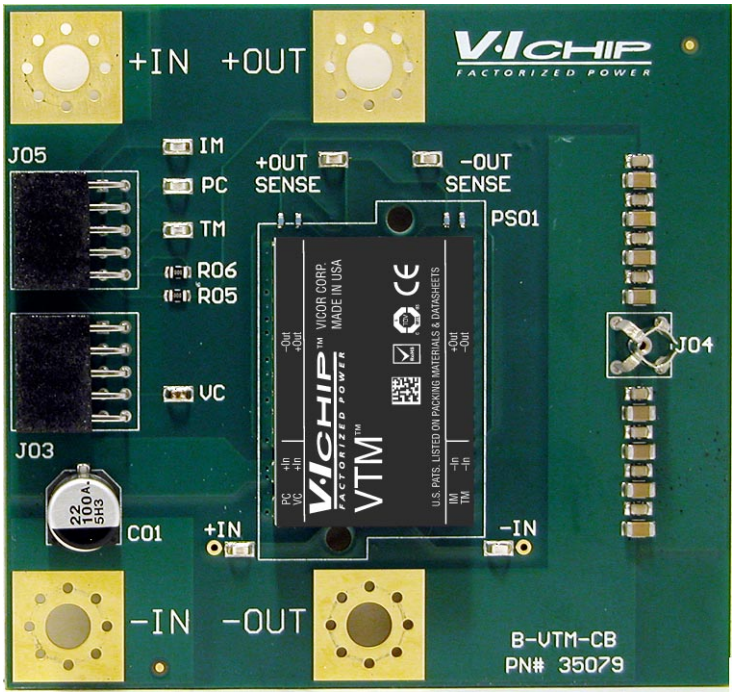
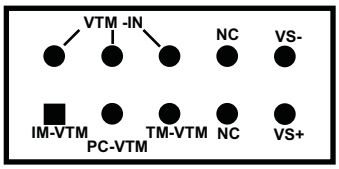
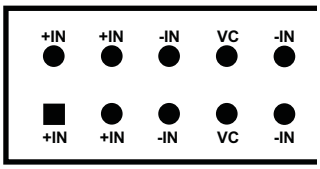


Figure 7: VTM Customer Board Type B



VTM™ CUSTOMER BOARD
TYPE B
Signal Connector



VTM™ CUSTOMER BOA
TYPE B
Power / Signal Connecto

Figure 8: VTM Customer Board Type B Connector Pinout (Front View)

6.0 Recommended Test Equipment

The following is a list of recommended test equipment. Output load current, and voltage ratings are a function of the VTM® selected (if used).

1. DC Power Supply: 0 – 100 V, 500 W minimum.
   a. Set Overvoltage Protection (OVP) based on absolute maximum rating of PRM®.
2. Load: Rated appropriately based on output voltage, current, and power requirements. Electronic load, 0 to 100 V, 130 A minimum recommended.
3. DMM(s).
4. Oscilloscope + Probe(s).
5. Interconnect cables and fastening hardware.
6. Calibrated input and output shunts, appropriately rated.
7. Trim Pot screwdriver
8. Fan
9. Data sheets for requisite PRM and VTM devices used.
10. Safety glasses.

7.0 Push Pin Heat Sink Installation

Each PRM and VTM Customer Board comes with its own heat sink and push pins for installation. Before testing, it is highly recommended that heat sinks be installed in the appropriate location for each board. When installing the push pin heat sink, use caution not to exceed the maximum compressive on the device listed in the data sheet.

8.0 Test Configurations

The half-chip PRM-RS Customer Board is designed to work in a number of different configurations as described in the following section. The scope of this document is limited to describing a single PRM Customer Board as a stand-alone or connected to a single VTM Customer Board. Other configurations may be possible, though they cannot be guaranteed to have stable operation with the components designed onto the board. If testing is to be performed outside of the recommended configurations, the design should be evaluated to determine if changes to any of the onboard components are necessary.

8.1 PRM Stand-alone Operation

In this configuration, the PRM output voltage is sensed through the divider formed by R40 and R23. U09B is configured as a buffer as illustrated in Figure 9, and provides the sense voltage to the error amplifier (U09A). R24, and R29 are left open, reserved for differential sensing. R40 is set to limit the upper trim range based on a maximum reference voltage of 1.25 V.

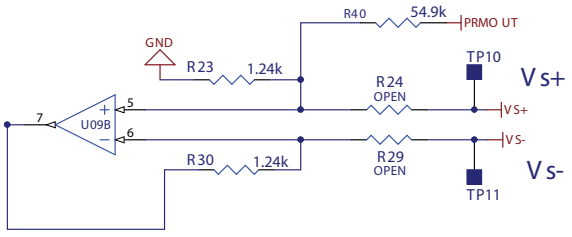


Figure 9: Local Sense Configuration

8.1.1 PRM® Stand-alone Operation Setup

This is the nominal configuration, and requires no rework to implement. If the board has been modified, restore to its original configuration.

1. Solder test leads to signals on the test point header that will be measured.
2. Connect input source to the input lugs. Verify proper polarity. Set to 0 Volts or OFF before connecting.
3. Connect output to load using the output lugs. Set load to 0 Amps or OFF.
4. Insert oscilloscope probe into J01 if used.
5. Connect DMM to the output test points (V_{OUT+}, V_{OUT-}) and to any other signals to be measured.
6. Set PC Enable Switch (S01_2) to the left position.
7. Apply nominal input voltage.
8. Measure output voltage and verify operation.
9. Use the output voltage trim pot (R_{22}) to adjust the output to the desired level.
10. Apply 100% load, and verify full load operation.
11. Turn off load and power. Proceed to following sections for detailed test procedure.

8.2 PRM – VTM® Operation, Local Sense

In this configuration, the PRM-CB and VTM-CB are connected together to form a PRM/VTM pair and regulation is performed at the PRM output. Load regulation will be degraded due to the VTM output resistance. Tighter regulation can be achieved by implementing non-isolated remote sense as described in Section 8.3.

8.2.1 PRM – VTM Local Sense Setup

Local sensing is the nominal configuration of the customer board and requires no rework to implement. If the board has been modified, restore it to its original configuration.

1. Solder leads to any signals on the test point header to be measured.
2. Identify the type of VTM Customer Board to be used (Type A, or Type B).
   a. Type A: Install single male-to-male header to X01 only.
   b. Type B: Install dual male-to-male headers on X01 and X03.
3. Connect desired VTM board referring to Figure 11 or Figure 12.
4. Connect input source to the input lugs. Verify proper polarity.
   Set to 0 Volts or OFF before connecting.
5. Connect VTM output to load using the output lugs. Set load to 0 Amps or OFF.
6. Insert oscilloscope probe into VTM output probe jack.
7. Connect DMM to the VTM output test points and to any other signals to be measured.
8. Set PC Enable Switch (S01_2) to the left position.
9. Apply nominal input voltage.
10. Measure VTM output voltage and verify operation.
11. Use the output voltage trim pot (R_{22}) to adjust the output to the desired level.
    a. Do not trim below the minimum input voltage of the VTM used.
12. Apply 100% load, and verify full load operation.
13. Turn off load and power. Proceed to following sections for detailed test procedure.

8.3 PRM – VTM® Operation, Non-isolated Remote Sense

In this configuration, the PRM and VTM Customer Boards are connected together to form a PRM®/VTM pair and regulation is performed at the VTM output. U09B is configured as a differential amplifier with a gain set for the appropriate output voltage. R24,and R29 set the gain and limit the maximum VTM output voltage based on Equation 1 assuming the trim pot (R22) is fully clockwise.

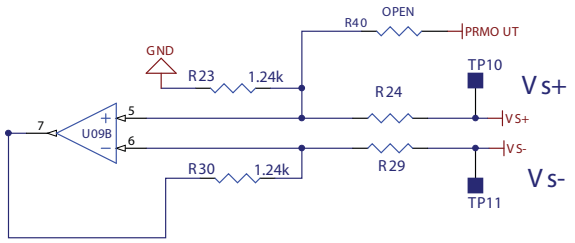


Figure 10: Remote Sense Configuration

Equation 1

$$R_{24} = R_{29} = \frac{V_{OUT_SET(MAX)} \bullet 1.24k\Omega}{1.25V} \approx V_{OUT_SET(MAX)}$$

Where: $V_{OUT_SET(MAX)}$ is the maximum VTM output trim voltage

8.3.1 PRM – VTM Remote Sense Setup

This is NOT the nominal configuration of the customer board and requires rework to implement.

1. Determine the maximum desired VTM output trim voltage (R_{22} fully clockwise).
2. Use Equation 1 to select the appropriate value for R_{24}/R_{29}. Obtain the closest 1% standard value, size 1206 resistors for installation.
3. Remove R_{40}.
4. Install R_{24} and R_{29} in the appropriate positions
5. Determine the type of VTM Customer Board to be used.
   a. Type A:
      i. Install single male-to-male header to X01 only.
      ii. Connect PRM and VTM Customer Boards together as illustrated in Figure 11.
      iii. Connect the VS+ test point to the VTM +OUT test point, and VS- test point to the VTM –OUT test point through a twisted pair of wire
   b. Type B:
      i. Install dual male-to-male headers to X01 and X03
      ii. Connect PRM and VTM Customer Boards together as illustrated in Figure 12.
      iii. Verify connection from VS+ to VTM +OUT, and VS- to VTM -OUT
6. Connect a jumper between VTM –OUT and VTM –IN
7. Connect input source to the input lugs. Verify proper polarity. Set to 0 Volts or OFF before connecting.
8. Connect VTM output to desired load using the output lugs. Set load to 0 Amps or OFF.

9. Insert oscilloscope probe into VTM® output probe jack.
10. Connect DMM to the VTM output test points and to any other signals to be measured.
11. Set PC Enable Switch (S0_2) to the left position.
12. Apply nominal input voltage.
13. Measure VTM output voltage and verify operation.
14. Use the output voltage trim pot (R_{22}) to adjust the output to the desired level.
    a. Do not trim below the minimum input voltage of the VTM used.
15. Apply 100% load, and verify full load operation.
16. Turn off load and power. Proceed to following sections for detailed test procedure.

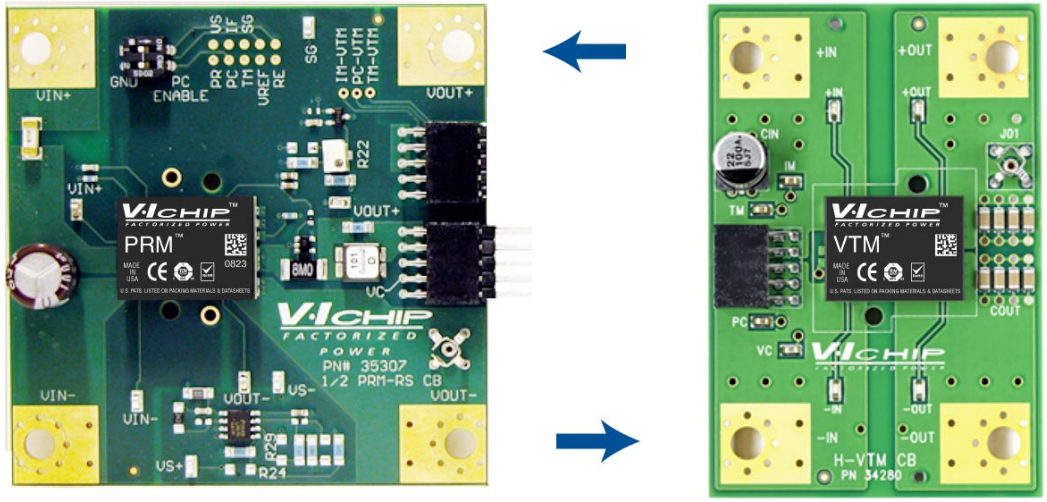


Figure 11: Half-chip PRM-RS Customer Board connection to VTM Customer Board Type A

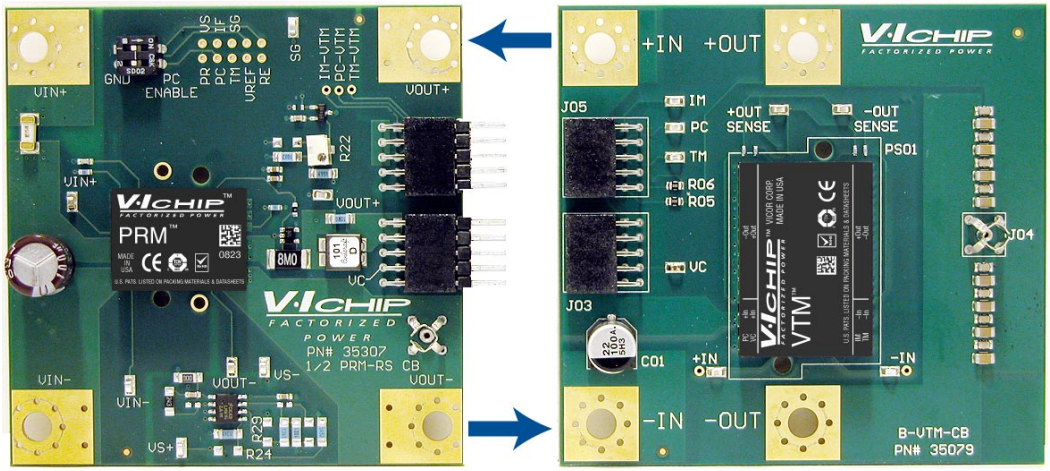


Figure 12: Half-chip PRM-RS Customer Board Connection to VTM Customer Board Type B

9.0 Test Procedure

Once the board has been setup and verified to be functional, it can now be used to characterize the behavior, and performance of the selected configuration. Some typical tests are outlined below.

9.1 Efficiency vs. Line / Load (Ambient)

1. Connect input source through calibrated input shunt noting the value. Set to 0 Volts or OFF.
2. Connect output to load through calibrated output shunt noting the value.
   Set to 0 Amps or OFF.
3. Connect DMMs to measure input voltage, output voltage, input shunt voltage, and output shunt voltage. Use Kelvin test points for input, output, and shunt voltage measurements.
4. Turn on fan for cooling. Make sure heat sink is installed.
5. Set PC enable switch to the Left position.
6. Apply desired input voltage and load.
7. Quickly record DMM measurements to avoid heating.
   i. GPIB control recommended for simultaneous DMM measurement recording.
8. Turn off input source and load. Allow device to cool to ambient temperature.
9. Repeat for all desired test conditions.
   i. GPIB control recommended for line/load sweeps.
10. Use data to calculate efficiency.

9.2 Output Ripple vs. Load

1. Connect input source and load. Set to OFF.
2. Insert oscilloscope probe into output probe jack.
3. Set oscilloscope:
   i. AC coupling 1 MΩ, 20 MHz bandwidth.
   ii. Time scale: 1 µsec / div
   iii. Voltage scale: 200 mV / division
4. Turn on fan for cooling.
5. Apply input voltage.
6. Apply load.
7. Record oscilloscope waveform. Use cursors to measure pk-pk ripple. Adjust scales as necessary.
8. Repeat for all desired conditions.

9.3 Startup Timing, Application of Input

1. Connect input source and load. Set to OFF.
2. Connect oscilloscope probes to V_{IN}, V_{OUT}, and any other signals to be measured
3. Set scope voltage, and time scales appropriately.
   i. 20 msec / div recommended time scale
   ii. Trigger on positive edge of V_{IN}
4. Apply desired startup load
5. Set input source to ramp from 0 to $V_{IN(NOM)}$.
   i. Ensure that the slew rate is within acceptable limits
6. Capture waveform. Adjust scales as necessary.

9.4 PC Enable / Disable Timing

1. Connect input source and load. Set to OFF.
2. Set PC enable switch (S01-2) to the right position to disable the PRM®.
   i. PC should be connected to SG.
3. Connect scope probes to PC, VOUT, and any other signals to be measured.
4. Set scope scales appropriately.
   i. 1 msec / div recommended.
   ii. Trigger on positive edge of PC.
5. Apply desired startup load.
6. Apply nominal input voltage ($V_{IN(NOM)}$).
   i. Verify unit is disabled.
7. Move S01_2 to the left position to enable the device.
8. Record Enable waveform. Adjust scales as necessary.
9. Trigger on negative edge of PC.
10. Move S01_2 to the Right position to disable the device.
11. Record Disable waveform. Adjust scales as necessary.
12. Monitor for switch bounce. Repeat measurement or adjust setup as necessary.

9.5 Current Limit

Note: In order for this test to be performed properly, a resistive load must be used. This includes an electronic load set to constant resistance mode. Be cautious of potential load interactions when using electronic loads. If the output voltage or current begin to oscillate, repeat the test with a passive resistive load.

1. Apply input source and load. Set to OFF.
2. If using an electronic load, change to Constant Resistance mode.
3. Connect DMMs to measure VOUT, IF, and any other signals to be measured.
   i. Use electronic load reading, clamp on DC meter to measure approximate output current or calibrated shunt for more accurate measurement.
4. Set S01_2 to Left position to enable the device.
5. Apply input voltage. Verify output is present.
6. Enable load. Gradually ramp up current (decrease resistance) until current limit threshold is reached.
   i. Current will remain at maximum, output voltage will fold back.

10.0 Advanced Modifications

10.1 Stability, Bandwidth and Transient Response

The nominal compensation of the half-chip PRM-RS Customer Board is set to provide relatively low bandwidth in order to ensure stability under all of the recommended configurations. The closed loop frequency response varies as a function of line, load, trim, and output capacitance. Refer to the PRM® data sheet for a detailed description and AC model. Adding additional capacitance to the output of the PRM or VTM® Customer Board may result in instability. When testing transient response, it is important for the user to understand that response is a function of compensation which should be optimized based on the end requirements for best performance. An example transient response waveform, taken with a passive resistive load, is shown below. As illustrated, the recovery time is on the order of 400 µsec. It should be noted that with control loop optimization, faster transient response recovery times are possible.

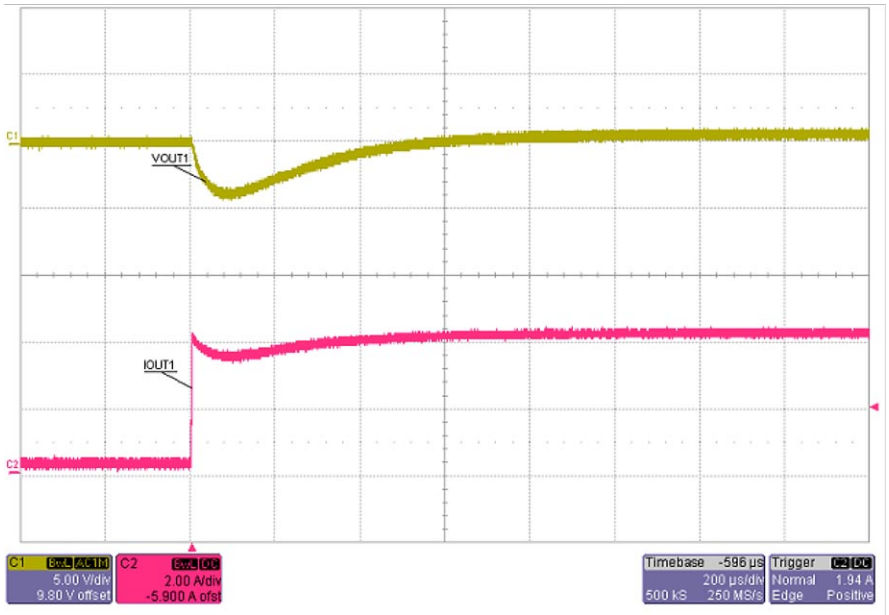


Figure 13: Example PRD48BH480T200A00 (VIP0100THJ-CB) transient response PRD48BH480T200A00 + V048F480T006-CB, Remote Sense Configuration

10.1.1 Compensation Adjustment

The sense and compensation circuit is shown below. Refer to the BOM (4.3) for component values. If higher bandwidth, faster transient response, and/or operation outside of the recommended configurations are desired, the user may adjust the compensation, referring to the appropriate PRM data sheet for guidelines. This type of tuning is highly recommended and generally requires the use of a network analyzer to measure the closed loop response. Stability must be verified across all line, load, and trim conditions. Typically maximum crossover frequency will occur at full load, and minimum crossover frequency will occur at minimum load. Examples of closed loop response plots are illustrated below.

Figure 14
Sense and Compensation Components

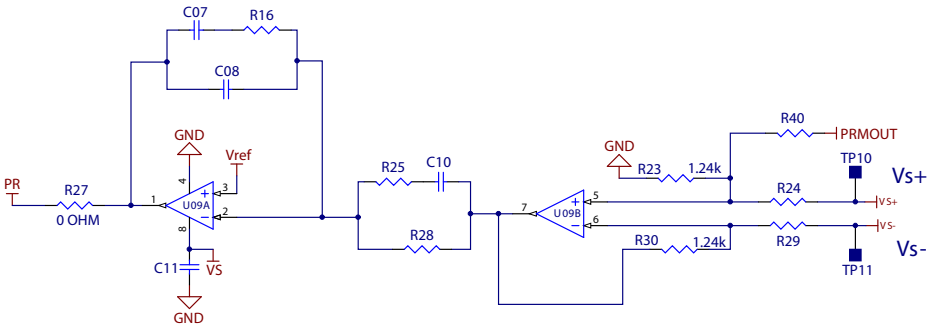


Figure 15
PRD48BH480T200A00 + V048F480T006-CB Closed Loop Response, Differential Sense, 48 VOUT, 0.2 A, Resistive Load

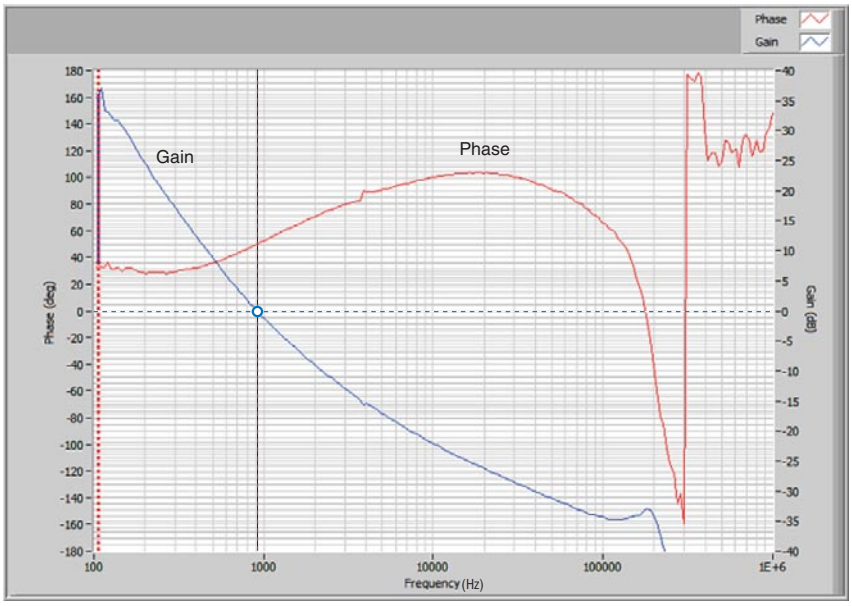
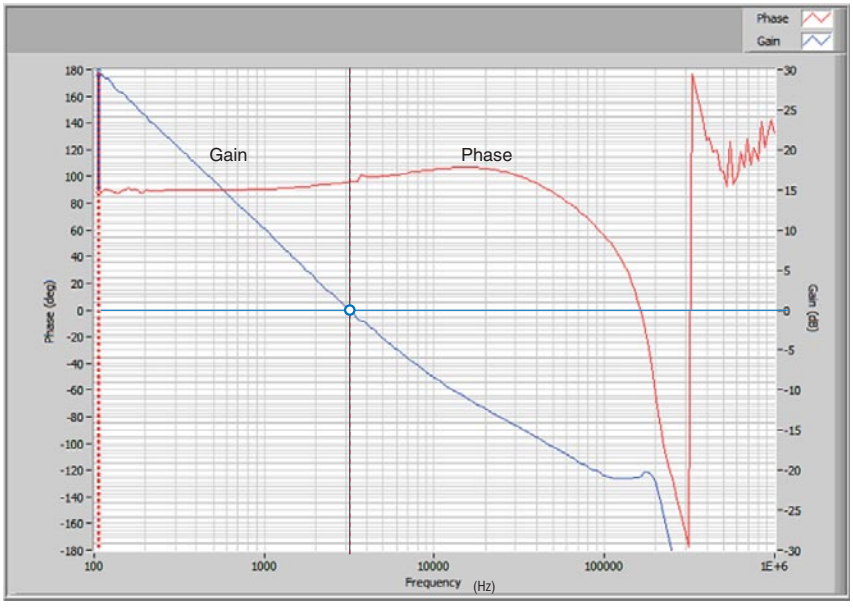


Figure 16
PRD48BH480T200A00 + V048F480T006-CB Closed Loop Response, Differential Sense, 48VOUT, 4 A, Resistive Load



10.2 Current Limit Adjustment

The current limit set point is a function of the current sense amplifier gain, the shunt resistor, and the internal current limit threshold of the PRM®. The onboard current sense IC and shunt have a typical combined gain of 400 mV/A. The gain of the current sense IC (Q_{02}) is fixed at 50 V/V, and the IF current limit threshold is fixed at 2.0V. The current sense shunt (R_{08}) can be changed per Equation 2 in order to adjust the current limit. Once the value has been calculated, obtain the closest 1% standard value, size 2512 resistor and replace R_{08}.

Equation 2

$$R_{08} = \frac{V_{IF_IL}}{I_{LIMIT(SET)} \cdot G_{CS}}$$

V_{IF_IL} is the IF current limit threshold (2.0 V)
$I_{LIMIT(SET)}$ is the desired current limit set point
G_{CS} is the current sense amplifier (Q_{02}) gain (50 V/V)

10.3 Trim Range Adjustment

The trim range is set by the reference voltage network shown below. The half-chip PRM-RS Customer Board is nominally configured for a 20 V to 55 V trim range. Any operation outside of the nominal trim range may require adjustments to the compensation.

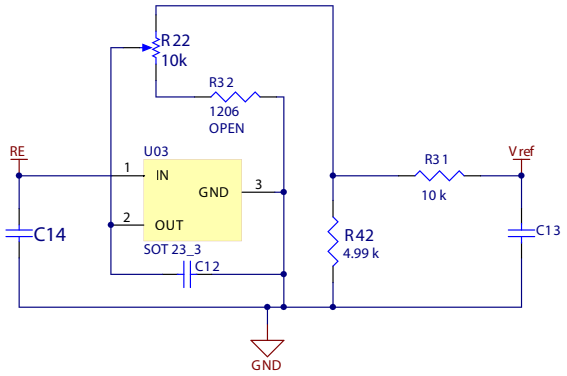
Assuming local sense is implemented, the output voltage is defined by Equation 3. Referring to Figure 17, the output of U_{03} is 1.25 V. When R_{22} is fully clockwise, the U_{03} output voltage will be applied directly to V_{REF} resulting in the maximum reference voltage. This, in combination with the voltage sense gain will determine the maximum output voltage. As R_{22} is turned counter clockwise, R_{22} and R_{42} form a divider which limits the minimum reference voltage.

In order to change the upper trim range, adjust the voltage sense gain (R_{40}) based on a maximum reference voltage of 1.25 V. In order to change the lower trim range, use Equation 3 to determine the minimum reference voltage required and adjust R_{42} appropriately. Before making adjustments to the trim range, refer to the data sheet to ensure that the device will operate outside of its rated limits.

Equation 3 (local sense only)

$$V_{OUT} = V_{REF} \cdot \frac{(1.24k\Omega + R_{40})}{1.24k\Omega}$$

Figure 17
Reference Circuit



11.0 Conclusion

The half-chip PRM-RS Customer Board is a flexible tool which allows users to implement and perform basic testing on a very wide range of configurations, including PRM®-VTM® combinations. This User Guide covers some basic and advanced topics; however, it cannot describe every scenario. If additional information is required, please contact Vicor Applications Engineering.

Technical advice furnished by Vicor is provided as a free service, with the intent to facilitate successful implementation of Vicor Products. Vicor assumes no obligation or liability for the advice given or results obtained. All such advice given and accepted is at user's risk.

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